EGYPTIAN
DENTAL JOURNAL

VOL. 63, 1739:1752, APRIL, 2017

I.S.S.N 0070-9484

FIXED PROSTHODONTICS, DENTAL MATERIALS, CONSERVATIVE DENTISTRY AND ENDODONTICS

www.eda-egypt.org • Codex : 89/1704

EFFECT OF LUTING AGENT VISCOSITY ON BOND STRENGTH AND MARGINAL GAB OF CERAMIC OCCLUSAL VENEER RESTORATIONS

Amal Abdallah A. Abo-Elmagd*

ABSTRACT

Objectives: The purpose of this study was to evaluate the effect of viscosity of composite resin as luting agent before and after heating on bond strength and marginal gab of two CAD/CAM posterior ceramic occlusal veneers restorations. The effect of heating on the flow of composite resin was determined.

Materials and Methods: 20 e. max and vita enamic discs (4x4x2mm) was prepared (Isometric 4000 micro saw Buhler USA) and cemented to grind enamel surface of mounted molars groups (heated and non-heated composite)according to manufacturer instructions and bond strength was measured by testing machine (Model 3345; Instron Industrial Products, Norwood, USA). also 20 extracted human premolars was prepared for occlusal veneers and the constructed e. max and vita enamic CAD/CAM was bonded using flowable composite resin cement before and after heating then marginal gap was measured before and after thermo-mechanical aging .The interface of debonded surfaces was recorded. Internal gap was measured before cementation by a replica technique. Flow of composite resin was measured before and after heating using compressed composite discs (ANSI\ADA Specification No. 57 -1993). The data was tabulated and analyzed statistically.

Results: It was found that heating affected resin flow significantly ($p=0.0003 < 0.05$) as indicated by t-test where (heated resin mean value > non-heated resin mean value). Effect of heating of composite resin; totally it was found that heated composite resin affected marginal gap significantly ($p=0.0284 < 0.05$) where (non-heated resin mean value > heated resin mean value). Regardless to ceramic material groups, it was found that heated composite resin affected bond strength significantly ($p=0.0141 < 0.05$) as indicated by two way ANOVA test where (heated resin mean value > non-heated resin). Interaction between variables was not done coz the F value of ANOVA test showed non-significant interaction ($p=0.2611>0.05$)

Conclusions: Heating of flowable composite resin as luting before cementation improve the flow characteristics of composite resin, increase the bond strength of occlusal veneers, and reduce the marginal gab.

KEY WORDS: Ceramic occlusal veneers, composite viscosity, preheated composite, bond strength, marginal gab, CAD/CAM ceramic.

* Lecturer, Department of Fixed Prosthodontics, Faculty of Dental Surgery, Misr University for Science and Technology. (MUST)

INTRODUCTION

The main goal of restorative materials and clinically has been to find successful bonding to achieve long standing fixed restoration. The process of adhesion and successive adhesives generations, must be properly searched to ensure best results. Many clinicians after the placement of adhesive have used flowable composite as the first layer of composite resin to ensure precise wetting of the adhesive surface, while creating a layer with less polymerization stress. [1].

Many authors have reported that superior marginal adaptation of restoration was found with low viscosity materials where it has more fluidity and proper contact. They were reported that viscosity of composite resin is the property that determines the degree of molecular mobility. The preheating affect on the monomers and make it in a state of thermal stimulation that enhance the molecular motion, and fluidity [2-6].

Some researchers, has been tried to decrease the viscosity, improve the adaptation and lessen the microleakage of posterior resin composite restorations by using the calset composite warmer to preheat without impairment the properties of the polymerized material for ten minutes (54°C and 68°C). Many benefits of preheating composite resin are: easier extrusion from syringes; improved adaptation of the material to cavity walls, diminished potential to trap air and therefore less risk of voids at the margins or within the bulk of the material, enhanced monomer conversion and therefore improved physical and mechanical properties of the final restoration. The gap between the prepared tooth and the restoration is filled with the cement, decreasing the complication of the gap. [7-11] Therefore some authors has been recommended the use of preheated restorative hybrid composite resin for the adhesive luting of porcelain laminate veneers. [7, 12-13]

Conservative tooth preparation is important to preserve the healthy tooth structure, obtain natural contours, rehabilitate occlusion, maintain the periodontal health, and for the best physical properties of the restorative material. Therefore thinner, conservative restoration as occlusal veneers is recommended to provide the advantage of enamel bonding which offers superior bond strength as compared to dentin [14-16].

The success of ceramic bonding depends on a high-quality adhesion of the luting agent to both restoration surface and tooth structure and the micromechanical retention are intended to improve the bond strength. It was found that Pre-heated composite resin improves shear bond strength, microhardness value, and degree of conversion. When using composite resin in the clinic, mechanical properties and physical properties was increased by pre-heating the composite resin. Also it has been reported that Pre-heated composite can improve rigidity and resistance to degradation in the oral environment. [17-20].

The success of indirect esthetic restorations depend on many factors: marginal adaptation, preparation design and cementation system. Many studies reported that mean marginal gaps of 50 to 60 µm in full veneer crowns and 150 to 168 µm in mesio-occluso-distal (MOD) inlays fabricated using ceramic CAD/CAM materials. [21- 27].

However, the available data about the effect of pre heated flowable composite material as luting agent on shear bond strength and the marginal fit of CAD/CAM posterior ceramic occlusal veneers restorations are few. Therefore, the aim of this study was to study the effect of heating on flow of composite resin and effect of preheated flowable composite material as luting agent on shear bond strength and the marginal fit of the vita ceramic and e. max CAD/CAM posterior ceramic occlusal veneers restorations.

MATERIAL AND METHODS

In this study two different types of the Samples preparation was used according to measurement tests.

1st Preparation: samples for Shear Bond Strength test:

20 natural human upper molars was cleaned and was mounted horizontally, blocks was prepared using a specially designed and constructed circular mold with 25 mm diameter, and 10 mm height. (Green chemical cure resin powder and liquid Acrostone -Acrostone dental factory, Industrial zone, Madinat Alsalam). Flat buccal surface was prepared using 0.3 depth cutting diamond stone and tapered diamond stone and all teeth blocks was stored in saline solution at room temperature.

20 uniform square discs: Group 1:10 Vita Enamic CAD blocks (Vita Zahnfabrik, Bad Säckingen, Germany) and Group 2: 10 IPS e.max CAD, (Ivoclar, Liechtenstein) was prepared with 4mm diameter, 2mm thickness and 16 mm^2 surface area using IsoMet 4000 microsaw buehler USA with cooling system water to cool 2 anticorrosive agent 30:1 speed 2500rpm feeding rate 5 mm\min with diamond disc 0.7 mm thickness Buehler. Discs of e. max ceramic was crystalized for 24 min at 830 ^{o}F according to manufacture instruction using Vitadent P310 programmate Germany furnace. Each disc was polished separately according to manufacture instruction using Set technical vite Germany. The prepared discs from each group was divided randomly into 2 subgroups according to the cement treatment before cementation (heated or not heated). Subgroup i: not heated cement. Subgroup ii: heated cement.

Bonding procedures of the discs:

Each disc was treated with hydrofluoric etchant 5g (9.5%HF) buffered hydrofluoric acid gel (Bisco, Inc 1100W. Irving park Rd. Schaumburg, IL 60193 847-534-6000 USA) for 90 sec., was rinsed with a copious amount of water, then was air dried. The etched surface appeared dull and frosty. One to two layer of silane (Pentron clinical, Technologies, LLC, and 68 N. Plains Industrial Rd. Wallingford, CT USA 06492.203-265-7397) was applied according to the manufacturer instructions, and was dried with air syringe. Then was followed by application of bond, primer adhesive c&b 6ml\6gm (Pentron clinical, Technologies, LLC, and 68 N. Plains Industrial Rd. Wallingford, CT USA patent No. 203-265-7397).

The prepared tooth surface was etched with 37% phosphoric acid Etchant gel (Charm Etch, 37(LV) DENTKIST, Inc, 1412004 Korea). The gel was applied to the prepared enamel for 30 seconds and on the dentin for 15 seconds. Then, the etchant gel was removed with water spray and air dried. A bonding agent (primer adhesive c&b 6ml\6gm (Pentron clinical, Technologies, LLC, and 68 N. Plains Industrial Rd. Wallingford, CT USA patent No. 203-265-7397). was applied to the prepared tooth surfaces.

Finally, According to the manufacturer's instructions the discs was cemented with light - polymerizing flow composite 4 x 1.2gm syringe w/ tips (MASTER-DENT LC, Dentonics INC, USA 8382 REF: 19-414-A1). Subgroup i) cemented with not heated light - polymerizing flow composite cement and Subgroup ii) cemented immediately after composite heating with 60 °C heated light - polymerizing flow composite cement. (Incubator unit, LabTech LDO-080N Korea).

All discs was cemented using finger pressure and immediately received a static load of 1kg magnitude and maintained for 15 minutes, with specially constructed metal load device. and excess cement was removed. Then light cure unit (Ledition Germany) was used for 20s from all directions. The Cement margin was finished using flexible polishing discs (Sof- Lex XT Pop-On, 3M ESPE). All cemented discs was stored in saline solution and was ready for Shear bond Strength measurement test.

Test procedure for shear bond Strength test with Area:

A rectangular interface shear test was designed to evaluate the bond strength. All samples was individually and vertically mounted on a computer controlled materials testing machine (Model 3345; Instron Industrial Products, Norwood, USA) with a load cell of 5 KN and data was recorded using computer software (Bluehill Lite; Instron Instruments). Samples was secured to the lower fixed compartment of testing machine by tightening screws. Shearing test was done by compressive mode of load applied at tooth-ceramic interface using a mono-bevelled chisel shaped metallic rod attached to the upper movable compartment of testing machine traveling at cross-head speed of 0.5 mm/min (Fig1). The load required to debonding was recorded in Newton. And the Shear bond strength was calculated by:

The load at failure was divided by bonding area to express the bond strength in MPa:

$\tau = P/A$ where; τ =shear bond strength (MPa, P =load at failure (N) and A =interfacial area(mm^2)

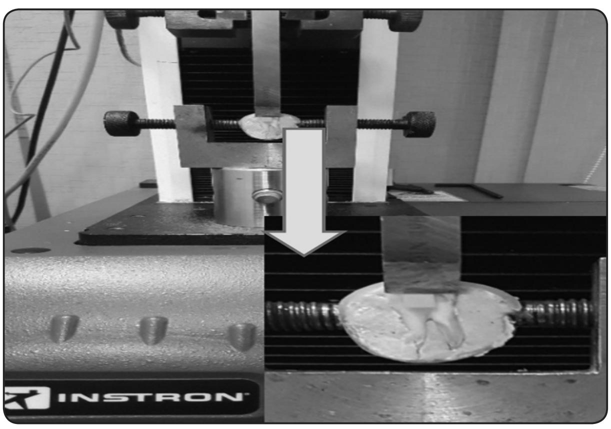

Fig. (1): Instron machine

Microscopical study of the debonded surfaces:

The mode of bond failure at 20 x magnification for both debonded surfaces of the discs and teeth was determined using stereo microscope (SZ OLYMPUS LG-PS2, SZ 40, and Japan). The results was recorded photographically.

2nd Preparation: the samples for marginal gab and internal fit measurements:

Teeth Preparation for occlusal veneers:

20 natural non-carious maxillary first premolar teeth, was selected. The occlusal surfaces of premolars was prepared for occlusal veneers with round end tapered diamond stone. Nearly flat occlusal surface was prepared, this allow construction of occlusal veneer with proper contour and standardize occlusal cusp morphology. Occlusal surface was prepared with a 1.5 mm from the cusp tip of occlusal surface and 1mm from deepest central groove. All line and point angles was rounded. Prepared teeth was divided into two groups of 10 teeth each. Each group was classified according to the type of veneers material into:

Group (1): IPS e .max CAD/CAM ceramic restorative material.

Group (2): Vita Enamic CAD/CAM ceramic restorative material

Each group was further divided into two sub-groups, of 5 teeth each according to the heating of the composite cement materials into:

Sub-group (a): non heated composite resin (1a and 2a)

Sub-group (b): heated composite resin (2b and 2b)

Construction of ceramic occlusal veneers:

- Group 1: IPS e.max CAD, (Ivoclar, Liechtenstein) occlusal veneers
- Group 2: Vita enamic CAD blocks (Vita Zahnfabrik, Bad Säckingen, Germany) occlusal veneers.

The prepared teeth was scanned using 3D optical scanner Identica blue (Medit, Korea), occlusal veneers of the corresponding tooth sample was designed using Exo CAD software, (Germany). Then all occlusal ceramic veneers designs was imported to the milling machine and CAD/CAM ceramic blocks was prepared using USF \ CAM 5 S milling machine (Germany). Then ceramic block was milled with cusp height 1.5mm and central fossa 1 mm. then marginal gap was measured before and after cementation.

Measurement of marginal gap before cementation:

A specially holding device was designed and was machined from wood in order to aid in specimen holding during gap evaluation. It consisted of 2 parts (A-B), A: Fixed base portion; rectangular in shape (10 cm length of 1.2 cm height and 2.3 cm width). The acrylic resin block will rest on this portion. B: Upper movable portion rectangular in shape (10 cm length of 1.2 cm height and 2.3 cm width). This portion is connected to the base portion through 2 metallic rods surrounded by spring wire to control the compressibility of the upper portion and fixed by tightening plastic caps. Also it is lined by rubber sheet to prevent friction that may cause any damage to the specimen (Fig 2a)

Each specimen was photographed using USB Digital microscope with a built-in camera (Scope Capture Digital Microscope, Guangdong, China) connected with an IBM compatible personal computer using a fixed magnification of 90X. A digital image analysis system (Image J 1.43U, National Institute of Health, USA) was used to measure and qualitatively evaluate the gap width. Within the Image J software, all limits, sizes, frames and measured parameters are expressed in pixels. Therefore, system calibration was done to convert the pixels into absolute real world units. Calibration was made by comparing an object of known size (a ruler in this study) with a scale generated by the Image J software. Specimens were held in place over their corresponding dies using a specially designed and fabricated holding device. Shots of the margins was taken for each specimen. Then morphometric measurements was done for each shot (4 equidistant landmarks along the cervical circumference for each surface of the specimen) (Mesial, buccal, distal, and lingual). Measurement at each point was repeated five times. Then the data obtained was collected, tabulated and then subjected to statistical analysis.

Measurement of Internal fit of occlusal veneer before cementation:

Internal discrepancy of the constructed occlusal veneer restoration was measured by a replica technique [28- 29]. Each one was filled with light-body (Speedex putty, Coltene, Bruksanvising (svenska), Switzerland-09083) and was inserted into the respective prepared tooth under a constant load (750 g) for 10 min, by means of a modified parallelometer. After the light-body silicone had set, the constructed occlusal veneer restoration was removed. Since it was not possible to remove the light-body from the interior portions of the crown without distorting it, a heavy-body (Speedex putty, Coltene, Bruksanvising (svenska), Switzerland-09083) was used to stabilize the light-body. Using a Paragon sharp stainless steel blade (n°. 23), the replicas was carefully sectioned into four equal segments (Fig 2b). From the four sections obtained from each replica, two opposite sections was used to measure internal fit, with

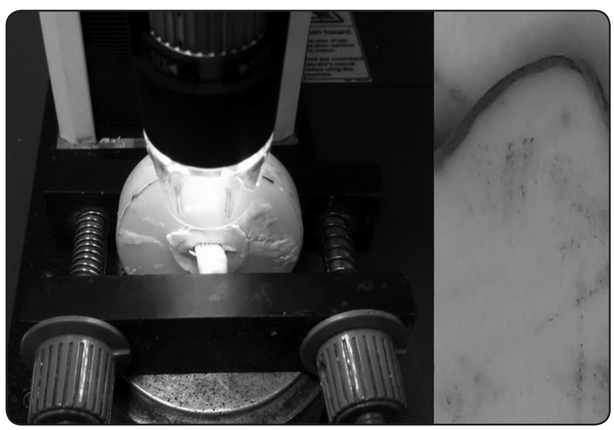

Fig. (2a and b): a) holding device. b) replica technique for Internal discrepancy three regions measured on each section (R = ray, A = axial, and Occl = occlusal), yielding 12 internal measurements for each coping. Using 3D optical microscopy at ×250 magnification and precision of 1 µm (Roi, RAM Optical Instrumentation, Irvine, CA, USA), the light-body thickness for all replicas was measured, representing the distance between the internal surface of the coping and the external surface of the preparation.

Cementation of occlusal veneers and measurement of marginal gap:

The internal surfaces of **v.** enamic and IPS e.max CAD occlusal occlusal veneers was prepared and was cemented (the same steps of ceramic discs cementation as discussed before was used). Then marginal gap was measured after cementation as measured before cementation as discussed before. The data obtained was collected, tabulated and then subjected to statistical analysis.

Thermo-mechanical aging of cemented occlusal veneers:

Multi-modal chewing simulator integrated with thermo-cyclic protocol operated on servo-motor (ROBOTA Model ACH-09075DC-T, AD-TECH TECHNOLOGY CO., LTD., GERMANY). Test parameters used: Cold/hot bath temperature: 5°C/55°C, Vertical movement: 2 mm, Rising speed: 90 mm/s, Descending speed: 40 mm/s, Cycle frequency 1.6 Hz, Torque; 2.4 N.m, Dwell time: 60 s, Horizontal movement: 3 mm, Forward speed: 90 mm/s, Backward speed: 40 mm/s. A weight of 5 kg, which is comparable to 49 N of chewing force was exerted. The test was repeated 37500 times to clinically simulate the 3 months chewing condition, accompanying thermocycling. After aging marginal gap of the cemented occlusal veneers for all groups was measured using the same methods of before cementation as discussed before. All data obtained was collected, tabulated and then subjected to statistical analysis.

Measurement of composite flow before and after heating:

The flow of flowable composite resins material was determined using disc diameter of at least 25 mm. (ANSI\ADA Specification No. 57 -1993) [30]. A volume of 0.5+ 0.02 ml of material, was placed between two glass plates (30mmx30mm) at room temperature, was placed on one of glass plates using the graduated syringe. At 180± 5 seconds after the commencement of mixing, amass of 0.98 ± 0.02 N (100 gf) plus the top plate with a mass of 20±2g shall be placed on top of the soft material. Ten minutes after the commencement of mixing the weight shall be removed and the average major and minor diameters of the compressed disc of material was recorded, if they agree to within 1mm. (ANSI\ADA Specification No. 57 -1993). The weight of the top glass slab was a constant pressure applied to each sample. After 4 minutes, the amount of flow was noted by measuring the diameter of the sample. Together, the glass slabs was then placed into a lab incubator at 150.3°F for 4 minutes .Then, the flow rate or the amount that the composite resin spread out was noted by measuring the diameter. A percentage increase was then calculated for each sample. The elevation in temperature did affect some composite resins more than others. (Figure 3)

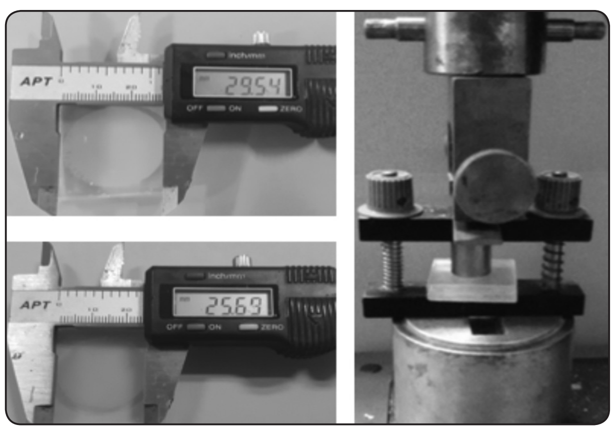

Fig. (3): Measurement of Flow of composite

Results of this study:

Data analysis was performed in several steps. Initially, descriptive statistics for each group results. Two-factorial analysis of variance ANOVA was done to detect the effect of each variable. Student t-test was performed to detect significance between paired and unpaired subgroups. Statistical analysis was performed using Aasistat 7.6 statistics software for Windows (Campina Grande, Paraiba state, Brazil). P values ≤0.05 are considered to be statistically significant in all tests.

Results of Shear Bond Strength test (Fig 3) and table (1):

Total effect of ceramic material; regardless to composite resin heating, it was found that material groups affected bond strength significantly (p=0.0447 < 0.05) as indicated by two way ANOVA test where (V. Enamic mean value > e.max mean value)

Total effect of heating of composite resin cement; regardless to ceramic material groups, it was found that composite resin heating affected bond strength significantly (p=0.0141 < 0.05) as indicated by two way ANOVA test where (heated resin mean value > non-heated resin). Interaction between variables was not done because the F value of ANOVA test showed non-significant interaction (p=0.2611>0.05)

TABLE (1) Shear bond strength results (Mean values ± SD) for all groups before and after composite resin heating

Variables Non-Heated		Composite resin heated	P value	Statistics
vs. ceramc	v. enamic	10.65 ±2.3	18.17 ±5.1	0.008*
	e.max	8.7 ±2.1	11.75 ±2.6	0.0803 ns
Statistics	P value	0.3524 ns	0.0436*	

Figure (3) Column chart showing shear bond mean values for experimental groups before and after resin heating

Results of stereomicroscope analysis of debonded surfaces: (Fig 4)

The two debonded surfaces of the all groups was recorded graphically at 20 x magnifications. Stereo microscope images revealed that most samples had adhesive cohesive failures, and the only difference was in the shape of failure and the amount of the remaining cement adhered to the disc surface, few images revealed that the failures was adhesive in nature.

Results of marginal gab:

The mean values and standard deviation of marginal gap (μm) as function of ceramic material group type, measurement stage and resin heating are summarized in table (2) and graphically drawn in figure (5).

TABLE (2) Marginal gap results (Mean values± SDs) as function of material group type, measurement stage and resin heating

	Before cementation	After cementation		After aging	
		Non-heated	Heated	Non-heated	Heated
e.max	38.75 ±8.6	48.28 ±8.6	45.18 ±6.9	45.32 ±7.6	36.43 ±5.5
v. enamic	58.24 ±10.9	74.53 ±7.9	66.62 ±11.5	54.25 ±19.5	46.67 ±9.7
P value	0.001*	<0.00018	0.004*	0.1089 ns	0.0158*

; significant (p < 0.05) ***ns; non-significant (p>0.05)***

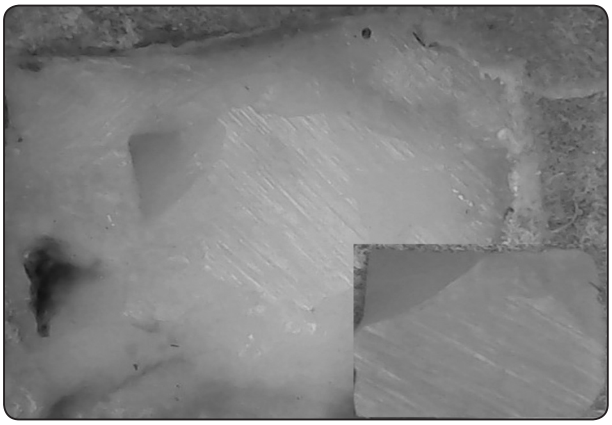

Fig. (4): stereomicroscope analysis of debonded surfaces

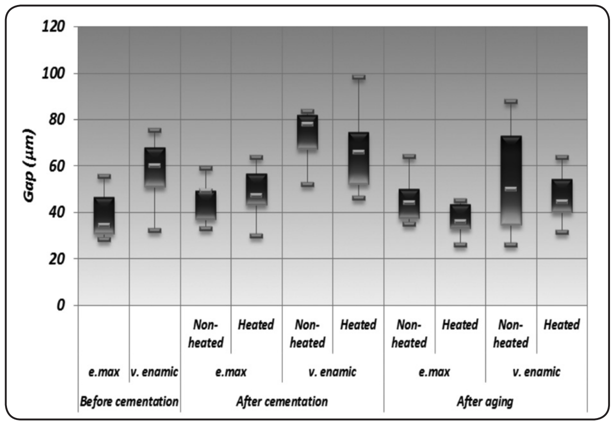

Fig. (5) Box plot of marginal gap mean values for both materials at different measurement stage with/out resin cement heating

Effect of ceramic material; it was found that v. enamic material group recorded higher gap mean values than e.max material group mean value. This was significantly ($p < 0.05$) at different stages with/out resin heating except after mechanical aging – non-heated resin where (v. enamic mean value > e.max mean value) non-significantly ($p > 0.05$).

Totally it was found that ceramic material type affected marginal gap significantly ($p=0.002 < 0.05$) where (v. enamic mean value > e.max mean value)

Effect of heating of composite resin

With e.max material group it was found that resin heating affected marginal gap non-significantly ($p=0.2436 > 0.05$) after cementation while significantly ($p=0.0127 < 0.05$) after aging although (non-heated resin mean value > heated resin mean value) at both stages

With v. enamic material group it was found that resin heating affected marginal gap non-significantly ($p=0.2349 > 0.05$) after cementation and after aging ($p= 0.4389 > 0.05$) although (non-heated resin mean value > heated resin mean value) at both stages

Totally it was found that resin heating affected marginal gap significantly ($p=0.0284 < 0.05$) where (non-heated resin mean value > heated resin mean value)

Effect of measurement stage

With both material groups; it was found that the lowest marginal gap recorded before cementation, statistically significant ($p<0.05$) highest marginal gap recorded after cementation while intermediate non- significant ($p>0.05$) marginal gap recorded after aging

Results of internal fit of restoration

The mean values and standard deviation of internal gap (μm) as function of material group type are summarized in table (3) and graphically drawn in figure (6).

It was found that e.max material group recorded higher internal (130.0698±18.90915 μm) gap mean values than v. enamic material group mean value (99.74984±9.73625μm). The difference between both material groups was statistically significant ($p<0.05$)

Results of the composite resin cement flow test

It was found that heating affected resin flow significantly ($p=0.0003 < 0.05$) as indicated by t-test where (heated resin mean value > non-heated resin mean value) are summarized in table (4) and graphically drawn in figure (7).

TABLE (3) Internal gap results (Mean values± SDs) as function of material group type

Variables		Mean ± SDs	Statistics
Material group	e.max	130.0698 ±18.90915	P value <0.0001*
	v. enamic	99.74984 ±9.73625	

TABLE (4) Flow test results (Mean values ±SD) before and after Composite resin cement heating

Variables		Mean ±SD	Statistics
Composite Resin cement	Nonheated	25.58 ±0.073	P value 0.0003*
	Heated	29.535 ± 0.003	

**; significant (p < 0.05)* *ns; non-significant (p>0.05)*

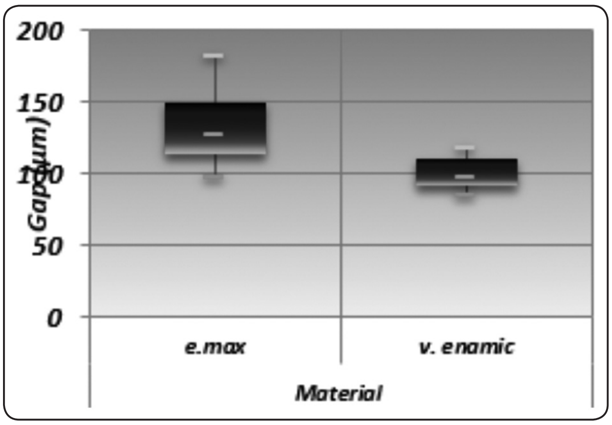

Fig. (6) Box plot of internal gap mean values for both materials.

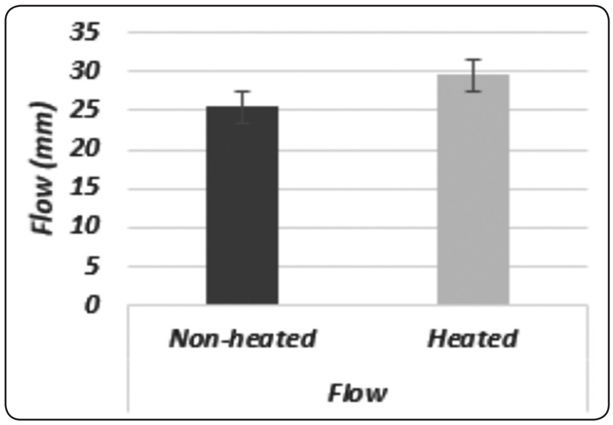

Fig. (7) Column chat showing flow mean values of Composite resin cement before and after heating

DISCUSSION

This study was to determine the effect of viscosity of flowable composite material as luting agent for two types of ceramic occlusal veneers restorations (vita enamic and e-max CAD/CAM posterior ceramic occlusal veneers) before and after heating of composite material on bond strength of human enamel and on the marginal gap of the occlusal veneer restoration. The flow of composite resin before and after heating also was determined. It investigated whether pre-heating of the light cure flowable composite resin as luting agent of ceramic occlusal veneer may be better for bonding when bonded to grind enamel.

Many methods can be used to heat composite resin before cementation: Calset composite warmer (AD Dent), Light of dental unit chair and Hand holding for 3 - 5 minutes. [17]. In present study, composite resin was heated at 60 °C for 2min using lab incubator unites and the effect of heating on the flow of composite was measured. The results of the composite resin cement flow test: revealed that heating affect composite resin flow significantly (p=0.0003 < 0.05) as indicated by t-test where (heated composite resin mean value > non-heated composite resin mean value) the flow of heated composite resin was 29.535± 0.003 while the flow of nonheated composite resin was 25.58±0.073. This results indicated that heating of composite resin improved the flowability of composite resin therefore decrease the viscosity of composite resin. This consisted with other study reported that curing at the elevated temperature might provide improved physical and mechanical properties and may result in more accurate adaptation to the marginal area. [17, 31-32].

Many researchers reported that the viscoelastisity of composite resin material, it may be the cause of the decrease of viscosity and increase of flowability when the temperature of composite resin material increased. It showed that the flow of composites increased up to 68% when the temperature of the composite resin increased with a warmer, Therefore the composite resin may have better adaptation to the tooth structure, which may decrease microleakage. [33-35].

From a previous study, it found that when the composite was heated to 54°C, 30% the film thickness of a microhybrid composite was decreased. The heating affect the flow of a composite resin and the degree varies among the type of composite and the flowability of pre-heated composite cannot reach to that of a flowable composite material [33, 36].

Barceleiro et al found that when bonding feldspathic porcelain to enamel using a dual-cure resin cement and a light-cure flowable composite, the same results was obtained. Therefore they advised the use of flowable composites as a suitable alternative luting agent when bonding porcelain laminate veneers. [37-38].

Prieto et al concluded that the use of a two-step etch-and-rinse adhesive with a flowable composite as a luting agent created an adequate seal at the bond interface at the enamel. Therefore many researchers preferred the use of flowable composite as an alternative in cementing ceramic inlays and veneers. [37, 39].

It appeared from this study that the total effect of heating of composite resin cement; regardless to ceramic material groups, it was found that composite resin heating affected bond strength significantly ($p=0.0141 < 0.05$) where mean value of non-Heated Composite resin v. enamic bond strength was10.65 ±2.3and for heated Composite resin v. enamic bond strength was 18.17 ±5.1 ,and mean value of non-heated Composite resin e.max bond strength was 8.7 ±2.1, and mean value of heated Composite resin e. max bond strength was 11.75 ±2.6. The results indicated that bond strength was increased when viscosity of composite was decreased due to heating, this results coordinate with other researches because increase the adaptation and decrease surface voids.

According to explanation of many previous studies, the higher shear bond strength, with higher temperature of pre-heated composite that it may be due to the fact that raising temperature of composite resin increase the free radical mobility and polymerization, and leads to a strong, cross-linked network. According to the gel effect phenomenon, a sudden increase in reaction rate happened. It is generally accepted that autoacceleration occurs due to changes in the termination rate constant, and a consequent increase in the concentration of free-radicals. For dental restorations the kinetics reaction of these multifunctional monomers is a multifaceted process exhibiting autoacceleration [33, 40 - 42].

Studying the interface of the two debonded surfaces of the all groups after shear bond strength revealed that most samples had adhesive cohesive failures, may be due to Surface treatments of ceramic materials using hydrofluoric etchant (9.5%HF) and layer of silane for improving the general adhesion properties of a material, by facilitating chemical and micromechanical retention between different surfaces. In the current study heating of composite resin cement, improve the flowability of composite resin and decrease the viscosity of composite resin was used.

From the analysis of the marginal gap results it was found that effect of heating of resin; with e.max material group resin heating affected marginal gap non-significantly ($p=0.2436 > 0.05$) while significantly ($p=0.0127< 0.05$) after aging although (non-heated resin mean value > heated resin mean value) at both stages. the v. enamic material group it was found that resin heating affected marginal gap non-significantly ($p=0.2349 > 0.05$) after cementation and after aging ($p= 0.4389 > 0.05$)

although (non-heated resin mean value > heated resin mean value) at both stages Totally it was found that resin heating affected marginal gap significantly ($p=0.0284 < 0.05$) where (non-heated resin mean value > heated resin mean value).

Frankenberger et al 2003 said that gaps may result from either insufficient compensation for the initial high polymerization shrinkage stresses that occur prior to occlusal loading, or from the lower, repeated stresses which are below the maximum stress the adhesive restoration could resist [43]

Many studies found that the pre-heating of the composites resin slightly above the temperature of the body can enhance the depth of cure of the composite material, enhance the conversion rate and decrease the time of healing by 50% .others found that reduces the viscosity, improves the flow of material allowing a better adjustment in the marginal areas without changing the composition, physical and mechanical properties. [44]

Marginal gap in the range of 100 µm have been reported to be clinically acceptable with regard to longevity of a restoration. All the results in this study were lower than this range. [45-47]

In the present study it was found that occlusal ceramic veneer material groups; it was found that the lowest marginal gap recorded after aging, statistically significant ($p<0.05$) highest marginal gap recorded after cementation while intermediate non-significant ($p>0.05$) marginal gap recorded before cementation

Marginal gap mean values reported in the present study for e.max non-heated cemented occlusal veneer (48.28 ±8.6µm) are higher than e. max heated cemented occlusal veneer (45.18±6.9µm) and before cementation was (38.75±8.6) while after aging it was found that for e.max non-heated cemented occlusal veneer (45.32 ±7.6µm) are higher than e. max heated cemented occlusal veneer (36.43 ±5.5µm) .

Marginal gap mean values reported in the present study for v. enamic non-heated cemented occlusal veneer (74.53±7.9µm) are highr than v. enamic heated cemented occlusal veneer (66.62±11.5µm) and before cementation was (58.24 ±10.9) while after aging it was found that for v. enamic non-heated cemented occlusal veneer (54.25 ±19.5µm) are highr than v. enamic heated cemented occlusal veneer (46.67±9.7µm).

Frankenbergera and Tayb(2005) were Compared the results of gap-free margins before and after thermo-mechanical fatigue loading, all adhesive systems showed a significant decline in the percentages of gap-free margins . [48]

Wagner et al concluded that the preheated composite resin resulted in significantly less microleakage at the cervical margin and found that delaying curing for 15 seconds after placing the preheated composite in the cervical margins caused increased microleakage therefore is not recommended [49].

In the present study, the mean marginal gap values showed differences between vita enamic (partially sintered) and e. max (fully sintered) occlusal veneer ceramic , the first exhibiting a higher mean marginal gap value. According to Bessimo et al also concluded that partially sintered show higher mean marginal gaps due to the shrinkage that occurs during final sintering. The milling process is faster and the wear and tear of hardware is less than the milling from a fully sintered blank. Also the difference between the milling burs could also be responsible for the variations between the 2 systems [50 - 52].

Internal discrepancy of the constructed occlusal veneers restorations was measured by a replica technique. The results of internal fit of restoration, the mean values and standard deviation of internal gap (μm) as function of material group type are that e.max material group recorded higher internal (130.0698±18.90915μm) gap mean values than v. enamic material group mean value (99.74984±9.73625μm).The difference between both material groups was statistically significant ($p<0.05$). The difference in the measurement of internal fit would affect the thickness of the luting composite cement.

Film thickness of the cement is important to improve seating of the restoration and marginal discrepancies to control plaque accumulation, periodontal disease, cement dissolution, and secondary caries formation.

Many Studies have shown that an increased film thickness of greater than 300 µm cause gradual decrease in fracture strength resulting to cracks and lower bond strengths in all-ceramic restorations . A high film thickness can prevent proper seating of the restoration and decrease the tensile strength of cast restorations. A lower cement film thickness (less than 50 µm) is better for all-ceramic restorations [53-55].

CONCLUSION:

According to the results of this study within its limitations, it can be concluded that: heating of composite resin has been shown to improve the flow characteristics of composite resin, increase the bond strength of occlusal veneers, and reduce the marginal gab. Therefore, pre-heating the composite resin could be recommended to enhance the physical properties of the restoration.

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